PATENT SPECIFICATION

(11) 1 460 986

(21) Application No. 34759/74 (22) Filed 7 Aug. 1974
(31) Convention Application No. 89329/73 (32) Filed 10 Aug. 1973 in
(33) Japan (JA)
(44) Complete Specification published 6 Jan. 1977
(51) INT CL² F16H 21/18//B30B 1/26 F16C 3/22
(52) Index at acceptance
F2K 4B1B 6A

(19)

1 460 986

(54) A ROTARY CRANK PRESS

(71) We, AIDA ENGINEERING KABUSHIKI KAISHA, a Japanese Company, of No. 2—10 Ohyama-cho, Sagamihara-shi, Kanagawa-ken, Japan, do hereby declare the invention for which we pray that a Patent may be granted to us and method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a mechanism for converting rotary motion into linear reciprocating movement and to a rotary crank press incorporating such a mechanism.

A principal object of the present invention is to provide a movement conversion mechanism for a crank press adapted to convert the rotational movement of the crank into the linear movement of the press ram member which is simpler in construction and production and which is suitable to be driven at high speeds.

According to one aspect of the present invention there is provided a mechanism for converting rotary motion into linear reciprocating movement, the mechanism comprising a shaft having an eccentric portion integrally formed therewith, the axis of the shaft and of the eccentric portion being offset from one another, a hollow sleeve rotatably received on the eccentric portion, the centre of the circular periphery of the sleeve being offset from the axis of the eccentric portion, a slider slidably received on guide means for reciprocating movement in a direction perpendicular to the axis of the shaft, the sleeve being rotatably received in the slider.

According to a further aspect of the present invention there is provided a rotary crank press including a rotatable crank shaft, a linearly reciprocating press ram member for operating a die of the press, and a mechanism according to the present invention drivingly connecting the crank shaft to the press ram member such that the press ram member is reciprocally moved on rotation of the crank shaft.

Reference is now made to the accompanying drawings:—

Figure 1 is a front elevational view of an embodiment according to the present invention.

Figure 2 is cross-section of the embodiment of Figure 1 taken along line 11—11.

Figures 3a, 3b, 3c and 3d are views showing various phases in a cycle of operation of the embodiment of Figure 1;

Figures 4a, 4b, 4c and 4d are views showing various phases in a cycle of operation of a modified embodiment according to the present invention;

Figure 5 are two separate graph plots showing the relationship between the rotation angle of the crank and the stroke of the slider of two different embodiments according to the invention.

Figure 6 is a part-broken away front elevational view of a rotary crank press incorporating a mechanism according to the present invention.

Figure 7 is a part-broken away front elevational view of another rotary crank press incorporating a mechanism according to the present invention; and

Figure 8 is a cross-sectional view taken along substantially the line VIII—VIII of Figure 7.

Figures 1 and 2 illustrates a conversion mechanism for converting rotary motion into a linearly reciprocating motion, the mechanism being suitable for incorporation in a rotary crank press to convert the rotational movement of the crank in the linear movement of the press ram member or slide in the rotary crank press. As shown in Figures 1 and 2, a crank shaft 1 is journalled at one end portion in a bearing block 4a which is in turn fixedly secured to the machine frame (not shown) and has an eccentric stub shaft 1a integrally formed with the crank shaft 1. A hollow rotary sleeve 2 having an eccentric bore 2a is rotatably disposed on the eccentric shaft 1a and its inner bore 2a loosely fitted on the eccentric shaft 1a for rotation about the latter. the center B of the eccentric stub shaft 1a is offset from center A of the crank shaft 1 by an amount E_1 and the center C of the circular periphery 2b of the rotary sleeve 2 is offset with respect to the center B

of the eccentric shaft 1a by E_2. The outer periphery 2b of the rotary sleeve 2 is rotatably fitted in a slider 3 which is in turn slidably received between a pair of guide members 4 fixedly secured to the machine frame (not shown) and having opposite and parallel guide faces 4′ and 4″ at right angles to the axis of the crank shaft 1. The guide members 4 are integrally formed with the bearing block 4a in which the crank shaft 1 is journalled.

The operation of the movement conversion mechanism described above is as follows:

It is assumed that the crank shaft 1 and its integral eccentric stub shaft 1a are rotated in the direction of arrow P about the axis Z of the crank shaft 1 (Figure 2) from the position as shown in Figure 1 in which the eccentric shaft 1a is at its upper dead point, i.e. the center C of the eccentric rotary sleeve 2 is offset with respect to the center B of the eccentric shaft 1a by E_2.

As the crank shaft 1 rotates, the rotary sleeve 2 is rotated in the direction Q opposite to the direction P and the slider 3 is moved in the arrow direction X. When the crank shaft 1 and its integral eccentric shaft 1a have rotated by an angular distance of almost 90° from the position of Figure 1, the rotary sleeve 2 reverses its rotational direction and begins to rotate in the direction Q′ while the slider 3 continues its movement in the arrow direction X. When the crank shaft 1 and eccentric shaft 1a have rotated by the angular distance of 180° from the position of Figure 1, the slider 3 has moved by the amount equivalent to twice as much as the eccentric amount E_1.

When the crank shaft 1 and eccentric shaft 1a have rotated by the angles of 180° from the position of Figure 1, the slider 3 reverses its movement direction and begins to move in the direction of arrow Y. When the crank shaft 1 and eccentric shaft 1a have rotated by the angle of 270° from the position of Figure 1, the rotary sleeve 2 reverses its rotational direction and begins to rotate in the direction of Q while the slider 3 continues its movement in the direction of arrow Y to return to its initial position as shown in Figure 1.

In this way, one complete rotational movement of the crank shaft 1 can be converted into the linear reciprocatory movement of the slider 3.

Figure 3 shows the embodiment in which the center A of the crank shaft 1 is positioned in the same vertical plane of the center C of the rotary sleeve 2 and Figures 3a, 3b, 3c and 3d show varying phases in the relationship between the crank eccentric shaft 1a and the rotary sleeve 2.

In this embodiment, when E_1=10 mm and E_2=30 mm, the relationship between the crank rotation angle and the slider displacement is as shown by curve R in the graph of Figure 5. In the embodiment of Figure 3, $L_2>L_3=L_1>L_0$.

In the embodiment of Figure 4, the center of the crank shaft 1 is positioned in a vertical plane laterally offset with respect to the vertical plane of the center C of the rotary sleeve 2 and shown at A′. Character reference D in Figure 4a corresponds to the position of the center A of the crank shaft 1 as shown in Figure 3a. Figures 4a, 4b, 4c and 4d show varying phases in the relationship between the crank eccentric shaft 1a and the rotary sleeve 2 in the embodiment of Figure 4.

In the embodiment of Figure 4, when E_1=10 mm, E_2=30 mm and E_3=10 mm, the relationship between the crank rotation angle and the displacement of the slider is as shown by curve S in the graph of Figure 5. In the embodiment of Figure 4, $L'_2>L'_3>L'_1>L'_0$.

In the graph of Figure 5, the curve R is substantially a sine curve while the curve S shows the upper dead point of the slider in the position displaced by about 15° from the upper dead point of the slider in the embodiment of Figure 3. The stroke S_1 of the slider in the embodiment of Figure 3 is 20 mm and the stroke S_2 of the slider in the embodiment of Figure 4 is greater than the stroke S_1 of the slider in the embodiment of Figure 3. And in the embodiment of Figure 4 (curve S), the lower dead point of the slider is offset with respect to the lower dead point of the slider in the embodiment of Figure 3 (curve R) by about 30° and the rotation angle Q_1 during which the slider displaces from the upper dead point to the lower dead point while the crank is rotating in the direction of arrow P is greater than the rotation angle Q_2 during which the slider displaces from the lower dead point to the upper dead point while the crank is rotating in the arrow direction P. This means that the return stroke is faster than the feed stroke in a cycle of operation of the rotary crank press.

Figure 6 shows a rotary crank press incorporating any one of the two embodiments of movement conversion mechanism referred to hereinabove. In the press of Figure 6, the slider 3 is shown as being formed with a depending extension which is also formed as an integral part of the press ram member 10 of the press. The slider 3 is guided in a direction at right angles to the axis of the crank shaft 1 along a pair of vertical guide bars 12 and 12′ the lower ends of which are secured to the machine frame 11 by means of suitable securing means.

Figures 7 and 8 show a modified embodiment of rotary crank press a movement conversion mechanism according to the present invention. This modified embodiment of press is substantially similar to the press as shown in Figure 6 except that the depending exten-

sion of the slider 3 is not formed as a part of the press ram member 10 of the press as in the case of the embodiment of Figure 6, but formed as a hollow cylinder 3′ which has a threaded bore for receiving an adjusting screw 13 which is suitably secured to and extends upwardly from the press ram member 10 so that the height of the slider 3 can be adjusted with respect to the press ram member 10.

The present mechanism is simple in construction and is cheaper to manufacture than conventional mechanisms. Furthermore, since the movement conversion mechanism is not subjected to any change in the mass of its moving parts, the press is subjected to less vibration. Furthermore, since the distance between the center of the crank and the press ram member can be made shorter than that in the prior art crank presses, the presses of the invention can be driven at high speeds. Finally, since the upper die comes into contact with the lower die at a relatively slower speed than that at which the upper and lower dies come to contact with each other in the conventional crank presses, the noise produced by a press incorporating the present mechanism is reduced when compared to conventional presses.

WHAT WE CLAIM IS:—

1. A mechanism for converting rotary motion into linear reciprocating movement, the mechanism comprising a shaft having an eccentric portion integrally formed therewith, the axis of the shaft and of the eccentric portion being offset from one another, a hollow sleeve rotatably received on the eccentric portion, the centre of the circular periphery of the sleeve being offset from the axis of the eccentric portion, a slider slidably received on guide means for reciprocating movement in a direction perpendicular to the axis of the shaft, the sleeve being rotatably received in the slider.

2. A mechanism according to claim 1 wherein the center of the circular periphery of the sleeve is offset from the axis of the shaft.

3. A mechanism for converting rotary motion into linear reciprocating movement substantially as described hereinbefore with reference to and as illustrated in Figures 1 to 3 or Figures 1 to 3 as modified by Figures 4 of the accompanying drawings.

4. A rotary crank press including a rotatable crank shaft, a linearly reciprocating press ram member for operating a die of the press, and a mechanism according to any preceding claim drivingly connecting the crank shaft to the press ram member such that the press ram member is reciprocally moved on rotation of the crank shaft.

5. A rotatory crank press according to claim 4 wherein the slider is integral with the press ram member.

6. A rotary crank press according to claim 4 wherein the slider is connected to said press ram member by adjusting means.

7. A rotary crank press according to claim 6 wherein the slider has a extension having an internally threaded bore, the bore threadedly receiving a screw secured to the press ram member.

8. A rotary crank press substantially as described hereinbefore with reference to and as illustrated in Figure 6 or in Figures 7 and 8 of the accompanying drawings.

ERIC POTTER & CLARKSON
Chartered Patent Agents
14 Oxford Street,
Nottingham.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1977
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

Fig. 1.

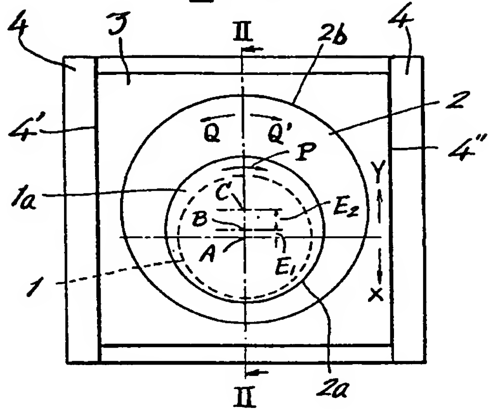


Fig. 2.

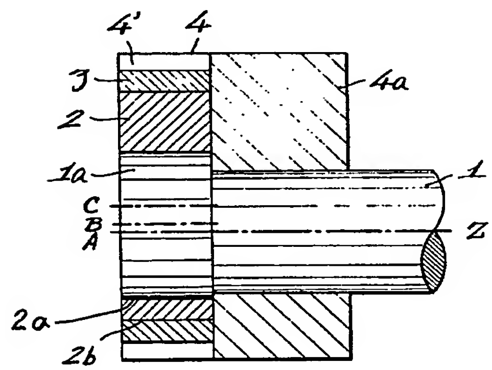


Fig. 3.

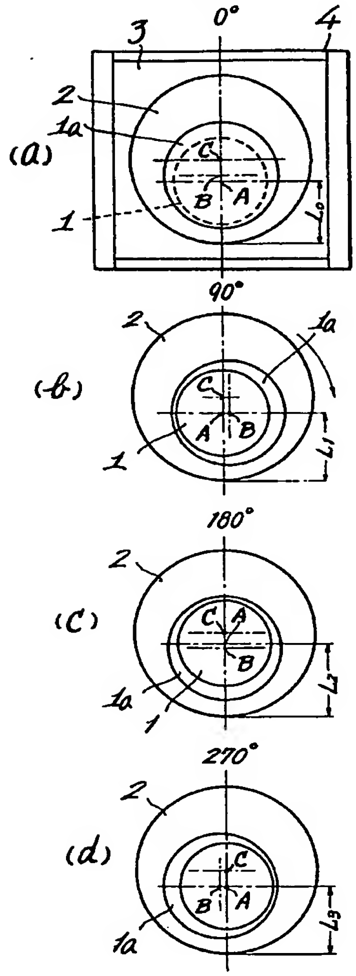
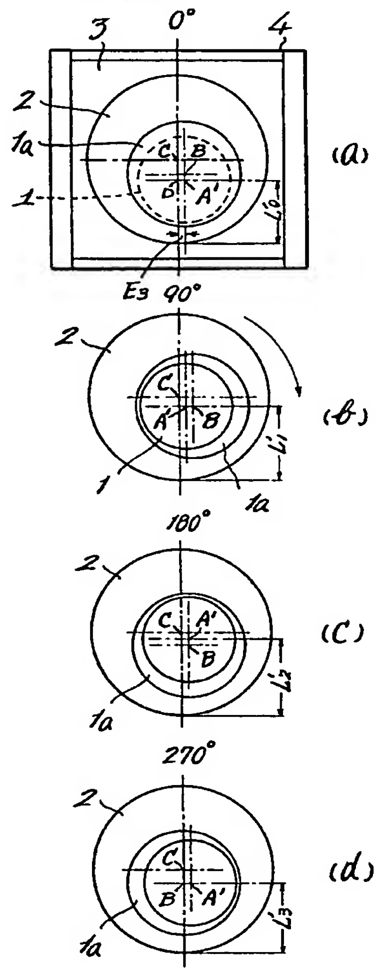

0°
3
4
2
1a
(a)
C
B
A
1
L0
90°
2
1a
(b)
C
A
B
1
L1
180°
2
(c)
C
A
B
1a
1
L2
270°
2
(d)
C
B
A
1a
L3

Fig. 4.


0°
3
4
2
1a
(a)
C
B
D
A'
1
L0
E3
90°
2
C
A'
B
(b)
L'1
1
1a
180°
2
C
A'
B
(c)
L'2
1a
270°
2
C
B
A'
(d)
L'3
1a

1460986 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

Fig. 5.

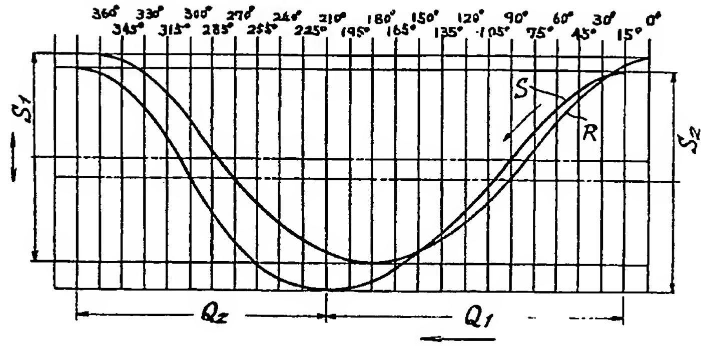


Fig. 6.

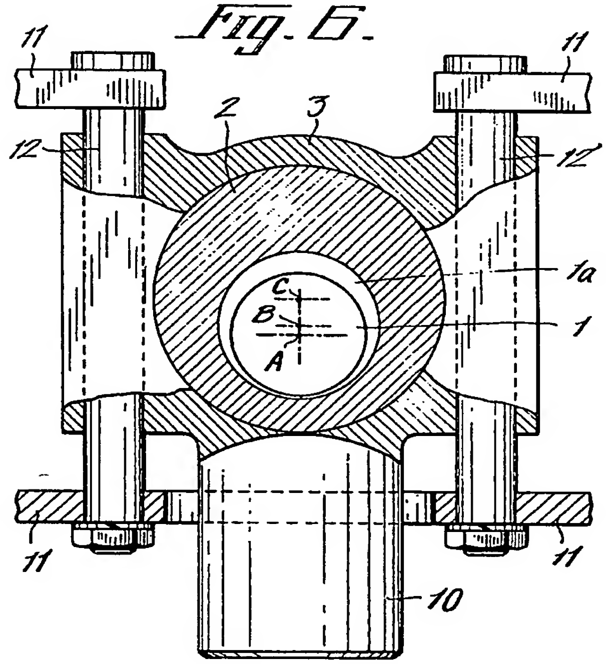
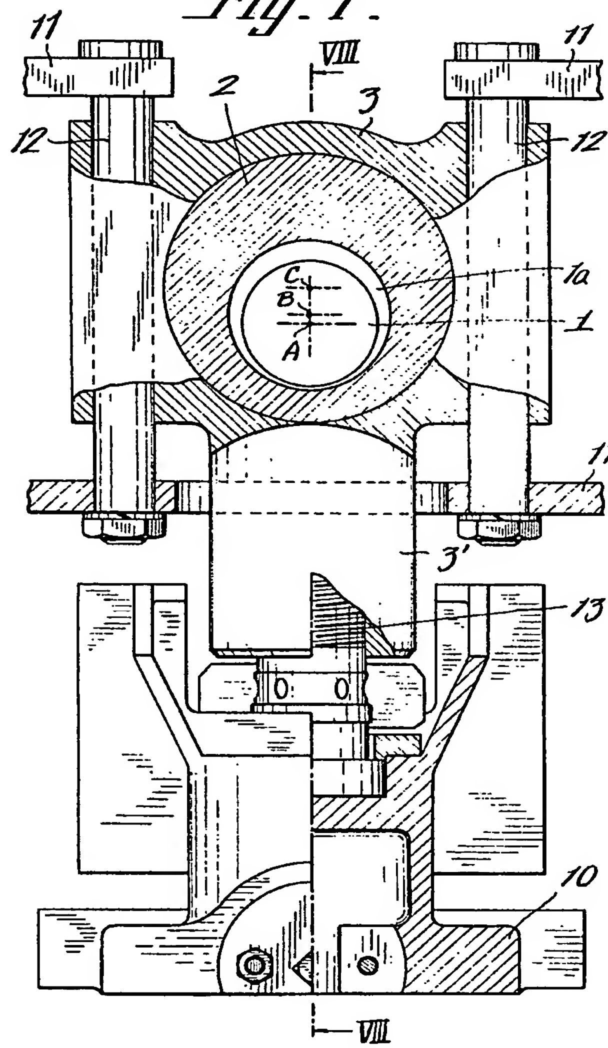


Fig. 7.



1460986 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 5

Fig. 8.